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(54) Valves

(57) A pilot operated check valve is provided for use in controlling the hydraulic leg 14 of a hydraulic mine roof support, the valve having means 23 to connect a leg extension port 18 to a return port 17 within the valve, when the valve is used to lower the leg 14. This provides more rapid operation than with prior art arrangements in which released pressure from the leg has to return from an extension port back to a remote spool valve controlling leg extension before reaching a return line.

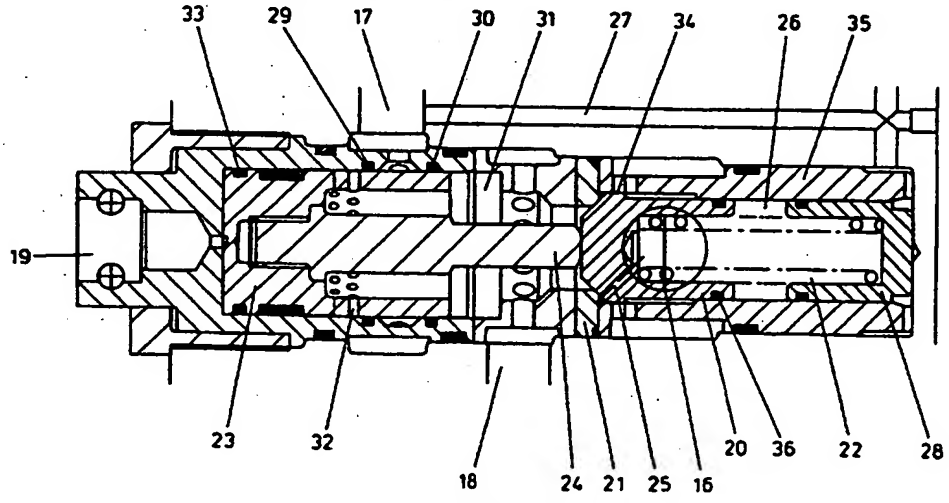

FIG. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

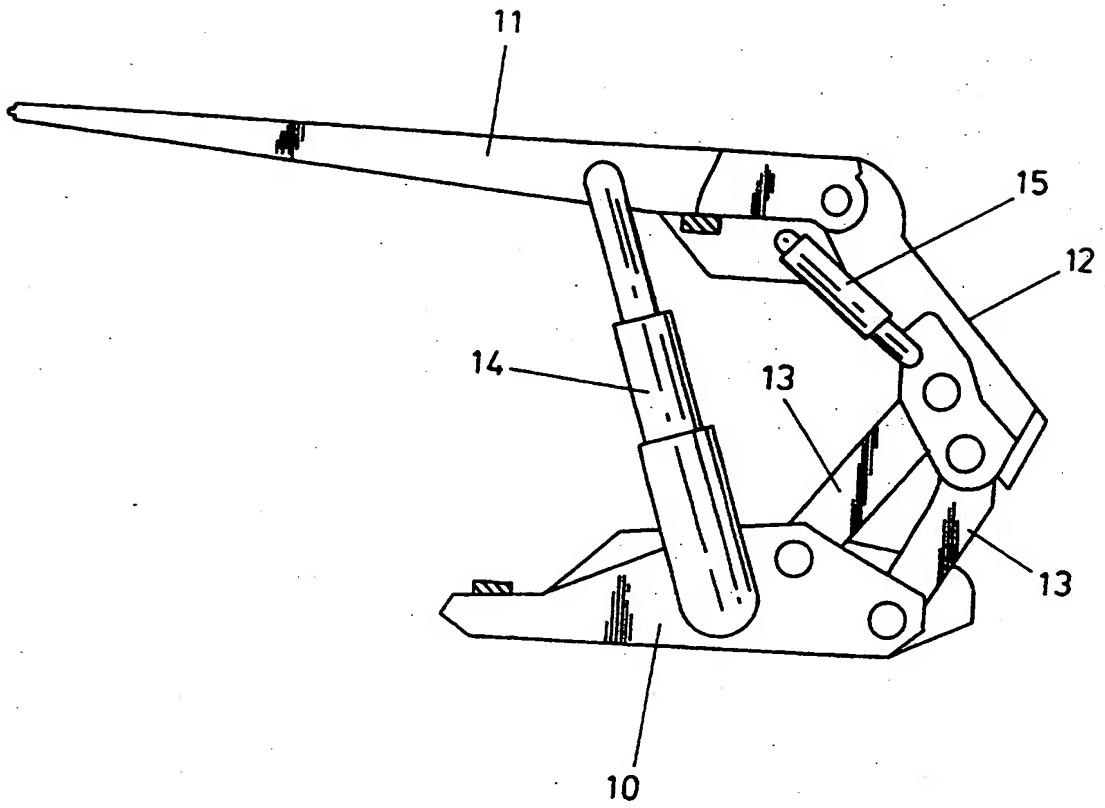

FIG. 2

VALVES

The invention relates to valves and particularly to valves for use in controlling the support legs of hydraulic mine roof supports.

Hydraulic mine roof supports are well known and generally comprise a ground engaging base, a roof engaging canopy, and a plurality of support legs each comprising a hydraulic jack acting between the base and the canopy.

A new generation of larger diameter legs is being developed to meet customer demands for higher rated supports. The flow capabilities of current control systems are at their limits and it is becoming increasingly necessary, to match the operating cycle time of the supports to the cutting rate of modern coal shearing machines, to provide additional boost valves.

The valves that are presently used to control the legs are known as pilot operated check valves. These are generally mounted directly to the legs and normally lock pressure in the head side of the cylinder of the hydraulic jacks. Leg extension and leg closure is controlled by the application of pressure to extension and closure ports of the valve. The delivery of fluid to the ports is controlled by spool valves.

When a leg is lowered using the present valves, the released pressure from the leg has to return from the extension port back to the spool valve controlling leg extension before reaching a return line.

The invention provides a pilot operated check valve for use in controlling the hydraulic leg of a hydraulic mine roof support, the valve

11. The angle between the canopy 11 and the shield 12 is controlled by a compensating ram 15 which can be hydraulically locked.

The valve shown in Figure 1 may be used with one or more of the legs. The valve has four ports. Port 16 is connected to the leg and port 17 is connected to a pressure return line.

When it is desired to raise the leg, pressure is applied to a port 18 under the control of a spool valve (not shown). When it is desired to lower the leg, pressure is applied to a port 19 using another spool valve (not shown).

Figure 1 shows the valve in its normal position, which it will adopt when the canopy 11 is set to the mine roof and support pressure is trapped in the legs.

Under these conditions, there will be no pressure at port 18 and the first valve member 20 is pushed against a valve seat 21 by a force applied by a compression spring 22. The seal formed between the cone of the valve 20 and the seating edge of 21 prevents fluid from escaping from the leg cylinder. A pilot piston 23 is also maintained in the position shown in Figure 1 by a spring 22, since the valve member 20 abuts against a stem 24 of the pilot piston 23.

The tendency for the roof and floor of the mine working to converge causes leg pressure to build up during mining operations and this build up of pressure at port 16 bleeds through a passage 25 and into a chamber 26 so this pressure is therefore felt by the tail of the valve member 20. Thus the seating

Pressure in the gallery 31 also acts over the cone end of the valve member 20 exerting a force attempted to push the valve member 20 off its seat 21. This force is resisted by a combination of :-

(a) the force of compression spring 22;

(b) the force exerted by leg pressure acting over the seat area; and

(c) the force exerted by return acting over the area of piston 28 if the return pressure is higher than leg pressure.

When the force generated by the pressure in the gallery 31 on the cone end of the valve member 20 exceeds the resisting forces the valve member 20 opens, allowing pressure to feed into the port 16 and to the cylinder head side of the leg, allowing the leg to extend. The flow to the leg is initially restricted as the flow path is through the annular gap 34 between the valve member 20 and the bore of a valve guide 35. This reduces the velocity of flow between the valve cone and the seat 21 as the valve member 20 lifts from the seat 21.

Pressure in the valve also feeds through a passage 25 into the chamber 26 between the valve member 20 and the piston 28. Thus the pressure forces acting on valve member 20 are balanced and the pressure loss through the valve is a function of the size of the equivalent open orifice, dependant on the displacement of valve member 20, plus the spring force.

When the leg set signal is turned off the set spool valve returns to its normal service to return position. Thus the pressure at port 18 and in the gallery 31 reduces. The pressure acting against the cone surface of the valve member 20 similarly reduces resulting in a force imbalance across the valve

hesitation is counteracted by the damping effect of the column of fluid in the chamber 26 and seal friction from a seal 36.

As the valve lifts further, the radial holes 32 in the pilot piston 23 traverse the seal 29 to a position that opens up a path from gallery 31 to the return port 17. Thus a path is opened directly to the return line, within the valve, in parallel with the path from the port 18 back through the set spool valve.

When the signal to lower the legs is turned off, the pressure at port 19 is decayed reducing the force holding valve member 20 open. Valve member 20 begins to close once the force generated by pressure at 19 is less than the pressure and spring forces acting in the opposite direction on valve member 20. As the valve member 20 returns to its seat 21, the force is transmitted through the spherical end of the stem 24 to the pilot piston 23. Thus, the radial holes 32 in the pilot piston 23 traverse the seal 29 shutting off the internal dump to return. Finally valve member 20 makes contact with its seat 21 sealing off the path to return from the leg collection to port 18, again locking pressure in the leg cylinder.

In use, the valve assembly may be bolted to the side of a leg cylinder. Port 16 links the leg pressure side of the seat 21 to a flow passageway in the wall of the cylinder. Pressure at the interface is sealed by an O-ring housed in a groove at 16. Ports 17 and 18 fall in a plane perpendicular to the axis of the cylinder so that hose connections can be made. The passage 25 is an angled drilling in the cone face of the valve member 20. Leg pressure from port 16 has to pass through radial holes in the valve guide 35 and the annular

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

The Patent Office

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Claims searched: 1 to 6

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Date of search: 24 February 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): F2V (VA20, VA22, VA26)

Int Cl (Ed.6): F16K

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	None	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.